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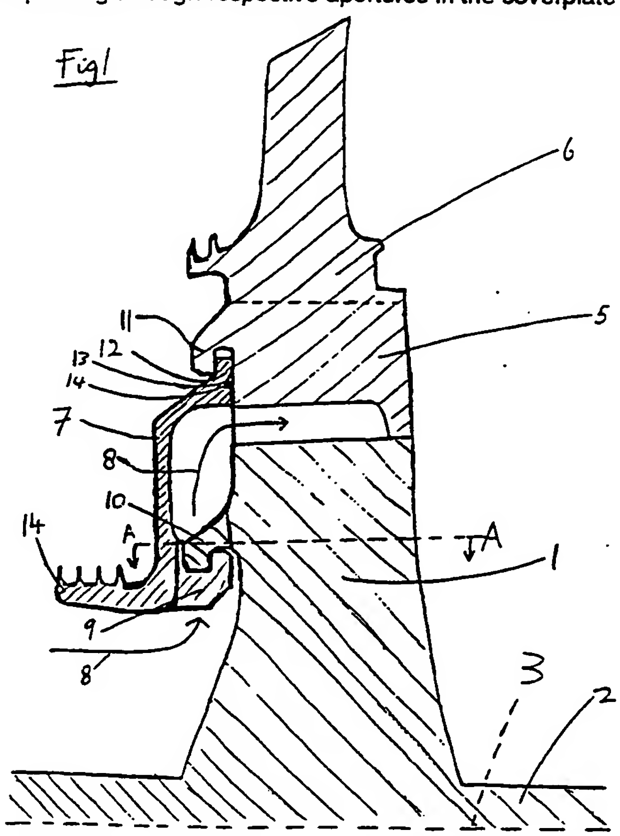
(54) Retaining gas turbine rotor blades

(57) A gas turbine rotor comprises a coverplate 7 supported by a turbine disc 1 and secured to it by a bayonet joint 9, 10. Turbine blades 6 are held in axial slots (4, Fig 3) in the disc 1 and each has a projection 11 which hooks over the rim of the coverplate to prevent axial movement of the blade. In assembling the rotor the blades 6 are first attached to the coverplate 7, the assembly so formed being combined with a turbine disc 1 such that the blades fit into axial slots in the disc after which the coverplate is rotated relative to the blades and disc to secure the coverplate to the latter. The rotational position is then fixed by means of a pin passing through respective apertures in the coverplate and the disc.

Fig 1



At least on drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig1

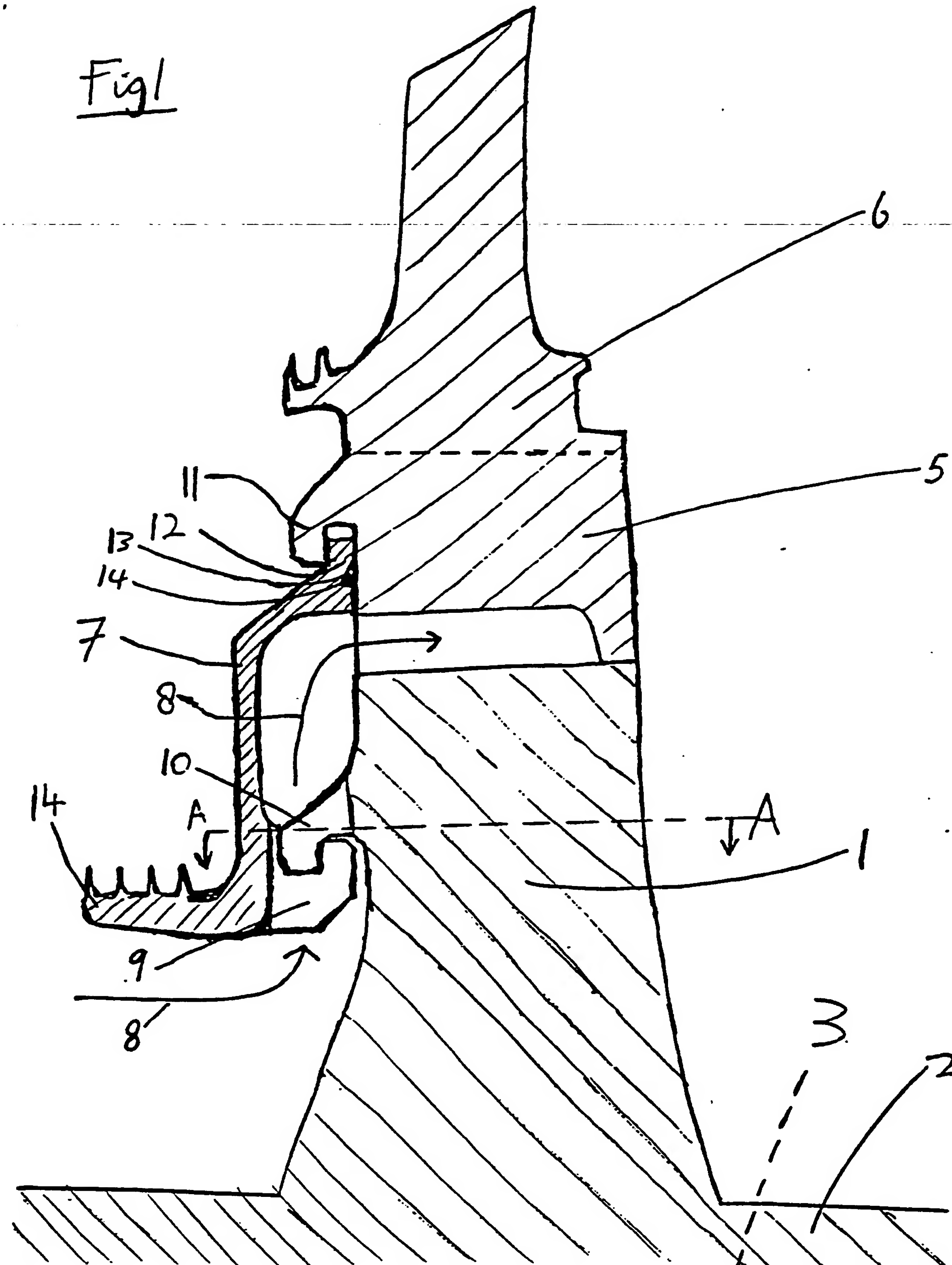


Fig 2

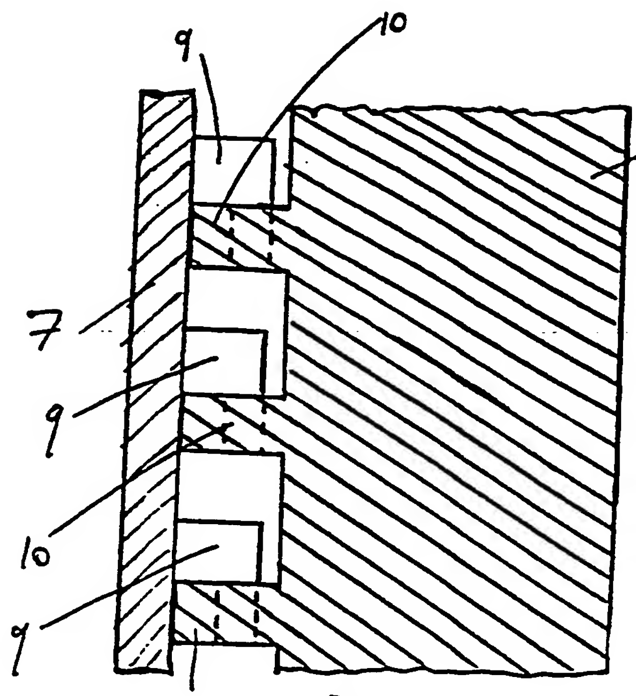
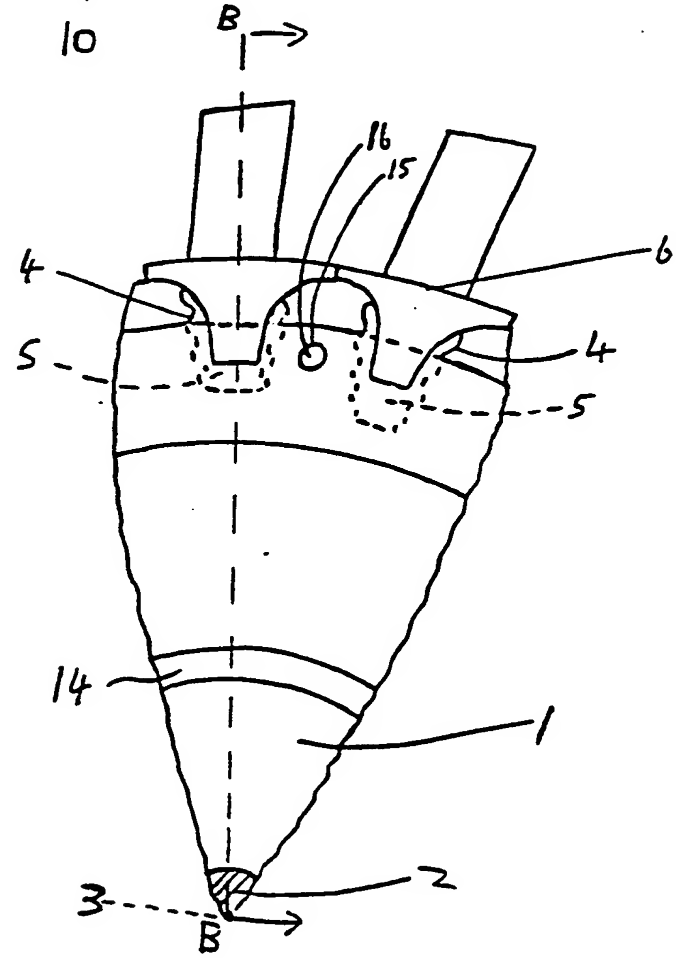


Fig 3



A GAS TURBINE STAGE

This invention relates to a gas turbine stage.

A gas turbine stage is generally formed by a central disk supporting a plurality of blades spaced around its outer rim. It is often necessary to cool the blades by passing air through internal passages within the blades and this air is supplied to the blades along a channel coaxial with the axis of rotation of the turbine and of smaller radius than the disk.

A cover plate is used adjacent to the turbine disk to define a radial flow path for this cooling air between the coverplate and the disk, the coverplate forming a seal with the disk at the coverplate's outer edge and directing the cooling air into passages leading through the turbine blade. Coverplates can either be self supporting or carried by the turbine disk.

In turbines having blades supported by their root portions fitting into axial slots arranged about the circumference of the disk, one design of disk carried turbine coverplate that has been used has tangs on the upstream faces of the turbine blade root portions and these tangs pass through cut outs in the coverplate so that the coverplate is prevented from rotating by the tangs on the blades. However a separate fixing mechanism must also be used to prevent axial movement of the blades and this makes assembly of the turbine and coverplate structure complex and time consuming and increases the centrifugal load which must be carried by the turbine disk.

This invention is intended to produce a coverplate at

least partially overcoming these problems.

This invention provides a gas turbine stage for use in a gas turbine engine comprising a turbine disk bearing a plurality of axial slots, a plurality of turbine blades having root portions within the slots and a coverplate carried by the turbine disk and cooperating with the turbine blades to prevent axial movement of the blades.

A gas turbine embodying the invention will now be described by way of example only with reference to the accompanying diagrammatic figures, in which;

Figure 1 shows a radial cross section through a gas turbine employing the invention,

Figure 2 shows a cross section along the line A-A in figure 1, and

Figure 3 shows an end view of the gas turbine of figure 1, identical parts having the same reference numerals throughout.

A turbine disk 1 is formed integrally with a shaft 2. This disk 1 and shaft 2 are arranged to rotate about an axis 3 when the turbine is operating.

A plurality of longitudinal slots 4 are spaced around the circumference of the disk 1. Each of the slots 4 cooperates with an inner root portion 5 of a turbine blade 6 to attach the blade to the disk and to support the loads acting on the turbine blades 6 when the turbine is operating. In operation the turbine blades 6 are exposed to a gas flow from left to right in figure 1.

The slots 4 run longitudinally through the disk 1. In other words the cooperating surfaces of the slots 4 and the blade root portions 5 run parallel to the axis 3.

A coverplate 7 is attached to the upstream face of the disk 1. The coverplate 7 is annular and directs cooling air which is travelling longitudinally along the engine, in the direction of the arrows 8 radially outward to the blade root portions 5.

The coverplate 7 is secured to the disk 1 by a plurality of hook shaped elements 9 projecting from the downstream face of the coverplate 7 and arranged at a constant radius from the axis 3. These elements 9 cooperate with an equal number of hook shaped projections 10 projecting from the upstream face of the turbine disk 1 at the same constant radius to form a bayonet joint.

Each of the turbine blades 6 bears a hooked projection 11 on the upstream face of its root portion 5, these projections 11 hook over the rim 12 of the coverplate 7 and as a result hold the blades 6 in a fixed axial position relative to the coverplate 7, the coverplate 7 is however free to rotate relative to the blades 6.

At its rim the downstream face of the coverplate 7 bears on the upstream face of the disk 1 between the outer edge of the disk 1 and the bottoms of the slots 4.

As the turbine disk 1 rotates about the axis 3 the centrifugal loads on the coverplate 7 will produce a couple which will act to rotate the coverplate 7 about the cooperating hook shaped el ments 9 and projections 10 in a clockwise direction in figure 1. This couple will bias the rim 12 of the coverplate against the upstream face of the disk 1. The turbine blades 6 are

fixed axially relative to the rim 12 of the coverplate 7, and the rim 12 is biased against the upstream face of the disk 1, so the turbine blades 6 are fixed axially relative to the disk. Downstream loading of the turbine blades 6 will simply bias the rim 12 more firmly against the disk 1 while upstream loading of the turbine blades 6 will counterbalance the centrifugal couple on the coverplate 7 and reduce the biasing load of the rim 12 on the face of the disk 1. Thus regardless of the direction of the loads on the turbine blades 6 the centrifugally induced couple on the coverplate 8 will keep the rim 12 of the coverplate loaded against the face of the disk 1 and so keep the axial position of the turbine blades 6 constant.

In order to prevent the cooling air escaping between the rim 12 and the disk 1 and blade root portions 5 a sealing groove 13 and wire 14 are set into the rim 12 where it contacts the disk 1. This seal works by the gas pressure and centrifugal loads on the wire 14 urging it outwards into the tapered gap between the faces of the groove 13 and disk 1 so that the wire 14 blocks any gas passage between the rim 12 and disk 1.

In order to assemble the turbine the blades 6 are hooked onto the rim 12 of the coverplate 7. The coverplate 7 is then pushed over the end of the shaft 2 and moved axially along the turbine until the root portions 5 of the turbine blades 6 go into the slots 4 and the coverplate 7 is in contact with the disk 1 with the elements 9 and projections 10 interleaved. The coverplate 7 is then rotated to engage the elements 9 and projections 10 to form the bayonet joint.

In order to prevent the coverplate 7 rotating relative to the disk 7 and thus releasing the bayonet joint a pair of matching holes 15 are drilled in the coverplate

7 and the disk 1 and a pin 16 is inserted passing through the coverplate 7 and into the disk 1. Only one pin 16 is required because in operation of the turbine only a relatively small couple will ever act between the disk 1 and the coverplate 7.

The coverplate 7 carries a sealing structure 14 on its face away from the turbine disk 1. In use this cooperates with a sealing structure on a stationary part of the engine (not shown) to form a labyrinth seal to prevent the cooling air for the turbine blades 6 escaping. Depending on the precise design of the engine as a whole a gas seal or seals of this or some other type may or may not be needed.

If desired the coverplate 7 could be fitted to the downstream face of the turbine disk 1, this would require the hooked projections 11 to be formed on the downstream end of the blade root portion 5.

CLAIMS

1 A gas turbine stage for use in a gas turbine engine comprising a turbine disk bearing a plurality of axial slots, a plurality of turbine blades having root portions within the slots and a coverplate carried by the turbine disk and cooperating with the turbine blades to prevent axial movement of the blades.

2 A turbine stage as claimed in claim 1 where each turbine blade bears a projection which hooks over an outer rim of the coverplate to prevent axial movement of the blade.

3 A turbine stage as claimed in claim 1 or claim 2 where the coverplate is attached to the turbine disk by a bayonet joint.

4 A turbine stage as claimed in any preceding claim where the coverplate is prevented from rotating relative to the turbine disk by a pin passing into an aperture in the coverplate and an aperture in the turbine disk.

5 A method of assembling a gas turbine stage, including the steps of:

i) attaching a plurality of turbine blades to an outer rim of a coverplate,

ii) moving the coverplate and attached blades towards a turbine disc so that the turbine blades fit into axial slots in the turbine disk.

iii) rotating the coverplate relative to the blades and disk to secure the coverplate to the disk and,

iv) fixing the rotational position of the coverplate relative to the disk.

6 A gas turbine stage substantially as shown in or as described with reference to the accompanying drawings.

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